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Examining pre-service elementary school teacher beliefs and instructional practices in mathematics class

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Abstract

The gap between theory and practice has become a critical issue in the effort of improving the learning of mathematics. Beliefs may have been one of the contributing factors to the widening of the gap between theory and practice. Therefore, examining the relationship between beliefs and practices in mathematics is crucial to gain an overview of the preparation of potential teacher candidates and the development of teacher education in the future. This study aims to examine the relationship between beliefs held by pre-service elementary school teachers and the instructional practices in mathematics class. This study employs the case study that focuses on one of the pre-service elementary school teachers who is undertaking practical field experience in the 2015/2016 academic year. The findings of this study indicate that the instructional practices do not necessarily reflect the beliefs that are held. On the other hand, beliefs about the nature of mathematics influence more dominant than the other beliefs against instructional practices.

Keywords: Teacher beliefs, pre-service elementary school teachers, instructional practices, mathematics class

Introduction

Basically, the school mathematics-based research has provided a valuable contribution to what is currently the best process for the acquisition of knowledge and skills (De Corte, 2003). The results of either quantitative or qualitative research or the combination of both leads to suggestions for the points that have to be considered in developing the teaching of mathematics in schools. However, the phenomenon of the gap between theory (including the results and recommendations of research) and practice in schools is the critical issue that needs to be raised to the "surface" (Geiger & Goos, 2006; Malone, 2000; Smith, 2000). The gap is an inconsistency between what is expected from the results of the research and decision making in practice at school.

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The teachers' belief is one of the potential factors contributing to the gap between theory and practice. The plausible reason for this is that belief becomes one of the variables that leads a person in making decisions (Pajares, 1992; Thompson, 1992). In addition, the instructional practices conducted by the teacher come from the decisions about something that is believed to be true, which comes from the knowledge that they have gained. In other words, the focus on building knowledge and beliefs is relevant to the stages of developing teachers' professionalism (e.g., Fennema, Carpenter, & Franke, 1992; Tatto et al., 2008; Vacc & Bright, 1999).

Empirically, on one hand, some researchers have found that teachers beliefs concerning the study of mathematics were consistent with their practices and behaviors in mathematics classes (e.g., Golafshani, 2005; Stipek, Givvin, Salmon, & MacGyvers, 2001; Zakaria & Maat, 2012). On the other hand, some researchers have found that there were inconsistencies between the beliefs and practices in mathematics classes (Barkatsas & Malone, 2005; Raymond, 1997). Barkatsas and Malone, through the case studies against a veteran teacher (i.e., Ann), found that Ann holds beliefs that are not always consistent with the instructional practices. The inconsistency is primarily caused by the class situation, experience, and social norms. The findings as disclosed by Raymond (1997) that in addition to the class situation, experience, and social norms, inconsistencies between the beliefs and instructional practices are influenced by internal factors (e.g., the teacher's personality) and external factors (e.g., the environment).

In Indonesia, the exploration of teachers' beliefs and practices is quite lacking, and it is the expectation of this study is able to give an overview and contribute suggestions to policymakers and subsequent researchers about how to build a strong foundation for developing the teacher education program. Some researchers agree that the golden period to build the professional teacher began when candidates were educated in College (Purnomo, 2015; Siegel & Wissehr, 2011; Volante & Fazio, 2007). Based on these reasons, this study focuses on examining the beliefs and instructional practices of pre-service teachers and the relationship of the related factors between the two variables.

Dealing with the Definition of Beliefs

Belief is an arbitrary construct designed in such a way that it is hard to give a simple definition. There are many variations of the concept of belief that is used in mathematics education research, so some researchers often formulate their own definition of beliefs that may even be contrary to others (Furinghetti & Pehkonen, 2002; Thompson, 1992). Some researchers looked at the beliefs in the cognitive domains (e.g., Thompson, 1992; Törner, 2002), other researchers put it in the effective domain (e.g., McLeod, 1992), and several others looked at the beliefs in both domains (e.g., Goldin, Epstein, Schorr, & Warner, 2011; Leder & Forgasz, 2002). Correspondingly, there are researchers who argued that the beliefs represent parts of the knowledge (e.g., Furinghetti & Pehkonen, 2002), some think that beliefs contribute to the attitude (e.g., McLeod, 1992), and the other state them as mere conceptions (e.g., Thompson, 1992).

Referring to an online dictionary (www.merriam-webster.com), beliefs may be defined as the conviction of the truth of some statement or the fact of some being or phenomenon, especially when based on the examination of evidence. Aligned with these definitions, some researchers consider that the characteristics of these beliefs refer to the degree of the person's conviction (Furinghetti & Pehkonen, 2002; Thompson, 1992). In other words, beliefs associated with the person's psychological strength may alter the degree of conviction. However, this raises further questions about what the conviction itself is. On one hand, Schoenfeld (1992) argues that beliefs can be defined as understanding and feeling of the individual which shapes the way that the individual conceptualizes and

affects their behavior. Furinghetti and Pehkonnen (2002) argue that the definition proposed by Schoenfeld is more akin to "how beliefs function".

Thompson (1992) defines beliefs as part of one's conception, namely a person's mental structure which includes knowledge, belief, understanding, preferences, and views. Thompson uses the terms beliefs and conceptions interchangeably because the differences were probably not very important to him. On the other hand, Ponte and his colleagues (Ponte, 1994; Ponte & Chapman, 2006) argued that the belief in stating that something is right or wrong, is not based around empirical evidence, and thus holds a proportional nature and does not require internal consistency. Meanwhile, a conception is a cognitive construction that can be seen as the organizing framework of the underlying concept.

Pajares (1992) distinguishes the term belief (conception) and knowledge, in which belief is based on evaluation and decision while knowledge is based on objective fact. Likewise, Griffin and Ohlsson (2001) stated that knowledge and belief refer to qualitatively different aspects of mental representation, in which knowledge refers to the representation of the proposition, and belief refer to the representation of the truth regarding the value of said proposition. Griffin and Ohlsson define knowledge as understanding or awareness of the ideas or propositions ("I understand the claim that humans evolved from monkeys"). After the proposition is known, one can accept it as true ("I believe the claim that ..."), reject it as false ("I do not believe the claim that ..."), or by reserving judgement ("I do not have an opinion about the claim that ... ").

Furinghetti and Pehkonen (2002) analyzed the relationship between belief and knowledge by dividing knowledge into two aspects: objective knowledge (i.e., knowledge accepted by the community) and subjective knowledge (i.e., knowledge created by an individual and does not have to be evaluated by others , see also Ernest, 1991, 1998). Furinghetti and Pehkonnen concluded from their analysis that beliefs refer to the individual's subjective knowledge, and when expressed as a sentence, may (or may not) be logically correct. Thus, the beliefs may not be 100% logically correct, while knowledge holds a 100% probability of being correct. Similarly, Leatham (2006) made an analogy of the relationship between beliefs and knowledge to describe that of everything we believe, there are some things that we ''just believe '' and other things that we ''more than believe '' because we ''know'' them. The things that we ''more than believe'' are reffered to as knowledge and the things that we ''just believe '' are called beliefs. Thus, beliefs and knowledge can be seen as complementary subsets of the set of things that we believe.

Abstract constructs on the definition of beliefs allow someone to give a conclusion based upon the individual perception. These constructs may occur because in order to lead the goal of research and being capable of describing each variable to focus on, the researcher should be able to give a decision and clarify the definition of the legal basis for the research focus. Therefore, this study assumes that beliefs can be in the cognitive domain if we emphasize the relationship between beliefs and knowledge. On the other hand, if the beliefs are seen from the reaction to a particular situation means we consider the beliefs associated with the affective part of individual (Furinghetti & Pehkonen, 2002). The definition of beliefs refers to the subjective knowledge of the individual (Furinghetti & Pehkonen, 2002; Op't Eynde, De Corte, & Verschaffel, 2002) based on the experiences (Raymond, 1997; Thompson, 1992) and expressed in [attitude] proposisional (Goldin, 2002; Griffin & Ohlsson, 2001; Pajares, 1992), views, and perception (Thompson, 1992) to a value of truth (Goldin, 2002; Griffin & Ohlsson, 2001). Thus, the term conception, [subjective] knowledge, belief, perception in this research is used interchangeably.

Method

Participant

This study uses case studies to explore the beliefs and instructional practices of one of the pre-service elementary school teachers, who shall be referred to as Sarijem (pseudonym) and the relationship and potential factors associated in between these two variables. Sarijem is a 7th-semester student, 21-years-old and ethnically Javanese. She is from a hometown of entrants who followed her parents working in Jakarta. Sarijem was born in East Java and has graduated from elementary school and junior high school in her native region and graduated high school in Pati, Central Java. In addition, all the schools were public schools. This study was conducted at the time when participants joined the program field experience in the academic year of 2015/2016 at one elementary school in East Jakarta. Sarijem has not had any previous teaching experience, so this study is intended to contribute to the development of teacher training courses, especially in elementary schools.

Data collection

Data were collected through a questionnaire, videotaped classroom observations and an interview. The questionnaire with open-ended questions focused on obtaining data on the beliefs about the nature of mathematics, and the beliefs about mathematics teaching and learning. Beliefs about the nature of mathematics are a viewpoint, perception or conception of someone's overall perception of mathematics as a discipline (Beswick, 2012; Ernest, 1989; Perkkilä, 2003; Thompson, 1992). Whereas, beliefs about teaching and learning is subjective knowledge or the implicit viewpoint of teachers on various types of teaching, the meaning of teaching and learning, the role of teachers and students in learning, how students learn mathematics, and class activities related to teaching mathematics (Chan, 2004; Ernest, 1989; Thompson, 1992). Videotaped classroom observations are used to obtain the behavioural and instructional practices in the classroom. In addition, beliefs, practices and related factors are explored with the semi-structured interview.

The questionnaire was given to Sarijem before she performed a series of classroom teachings. The questionnaire contains open-ended questions in the following order (adapted from Adam, 2012) .

1. How do you explain what mathematics is to someone who has never heard of mathematics before?

2. What do you think mathematicians do when they work with mathematics?

3. In your opinion, what is the best way for children to learn mathematics?

4. What methods do you have that can have an effect on the way students learn mathematics?

5. In maths class, what do you think about the role of (a) teachers and (b) students?

6. In your opinion, what is the most effective way of teaching mathematics?

The six 35-minute teaching sessions were videotaped in order to obtain data on instructional practices in the classroom. Sarijem taught the fourth grade with materials related to the greatest common factors and least common multiples.

After the series of teaching activities were completed, interviews were conducted to elaborate Sarijem's beliefs that she had stated in her answers to the questionnaire. The interview was carried out using similar questions to those asked on the questionnaire and was recorded using the audio-recording application on a hand phone. Furthermore, the

interview was also conducted to elaborate the instructional practices conducted by Sarijem and the factors associated with beliefs and practices. Some questions in addition to those contained in the questionnaire are shown as follows.

1. How do you teach mathematics?
2. Why did you introduce the mathematical ideas in this manner?
3. How did you help students understand the new ideas?
4. What encouraged you to teach in this manner?
5. What limits you in being able to teach mathematics in the way you want/plan?

Data analysis

The questionnaire responses were analyzed with an interesting pattern and elaborated through the interview. Related audio recordings and the transcribed interview was analyzed to describe the beliefs held by Sarijem. The pattern of responses related to the questionnaire and the interview are categorized into traditional beliefs (absolutist), primarily traditional, primarily constructivist, and constructivist (fallibilist) for the dimensions on the nature of mathematics and the teaching and learning of mathematics.

The recorded video was played and viewed together with the participant along with the interview to explore the teaching practices and limitations that the participant faced throughout the teaching sessions. This was done to confirm the answers to the questions stated in the questionnaire and the interview beforehand. The video footage and interview has been transcribed, then read and verified again by the participant to ensure the accuracy and thoroughness.

Results and Discussion

This section discusses Sarijem's beliefs by splitting them into two separate parts, i.e. beliefs about the nature of mathematics and beliefs about teaching and learning mathematics. The analysis of the interconnectedness of beliefs and practices as well as potential factors that influence them was addressed afterwards.

Sarijem's beliefs about the nature of mathematics

Based on the pattern of responses to the "open-ended questions" on the questionnaire and the interview session, beliefs about the nature of mathematics held by Sarijem leads to the combination of traditional and constructivist view, with primarily traditional mathematics. Sarijem states that mathematics is an exact science that is used by humans as a means of counting everyday problems. When asked more about mathematics, Sarijem stated that mathematics is a science that is applicable and relevant to a person's experiences and everyday problems. Ernest (1991) states that the constructivist view of looking at mathematics as part of a blend with the human culture, so that it cannot be separated with the knowledge of physical and other sciences. In other words, mathematics comes from and for social purposes.

> The researcher: How do you explain what mathematics is like to someone who has never heard of mathematics before?
>
> Sarijem: ... Mathematics is a science that is used by humans to help calculate
>
> ...include the symbols and rules to do the calculations....
>
> The researcher: Besides that, what else do you think about maths?
>
> Sarijem: Mathematics is also used in other studies and is relevant to the problems of everyday life.

The researcher: Earlier, you said that mathematics includes a collection of symbols and rules. According to you, who makes the rules? Is it the mathematicians or does everyone have a chance to make or add to them?

Sarijem: Mathematicians, sir, because mathematicians have a thought process that is coherent and logical ... if we're not coherent and logical thinking.

The researcher: Ok. Do you think that the mathematical rules that already exist could be wrong?

Sarijem: I think not, sir, because the rules have been established through a series of experiments and published afterwards.

Sarijem stated that the rules of mathematics are accepted to be true. The mathematical rules and facts can't be doubted and hold an undeniable truth. Furthermore, Sarijem also stated that the role of mathematicians is crucial in the development of mathematics. The mathematical objects are discovered by mathematicians through a series of experiments and published after perfection. Sarijem's views about maths are in line with the views held by an absolutist. Absolutists see mathematics as absolute truth, accepted by everyone, and does not rely on the human knowledge and context (Ernest, 1991; Hersh, 1997). The views absolutists can be associated with the platonic, formalist, and logicist views stating that mathematics is as absolute as a divine gift, a formal language without error or contradiction, does not depend on human knowledge, waiting to be discovered and has existed before the birth of mankind, a set of rules and procedures that are rigid and picture mathematics as essential calculations (Ernest, 1991; Hersh, 1997; Sriraman, 2004; White-Fredette, 2010). In other words, mathematical objects are taken for granted to be applied by the user.

Sarijem's beliefs about teaching and learning mathematics

Typically, Sarijem adopts beliefs about mathematics teaching and learning that is primarily constructivist-oriented. Sarijem stated that the best way to learn mathematics is by connecting mathematics with daily life. The following is Sarijem's statement about the best way to learn mathematics.

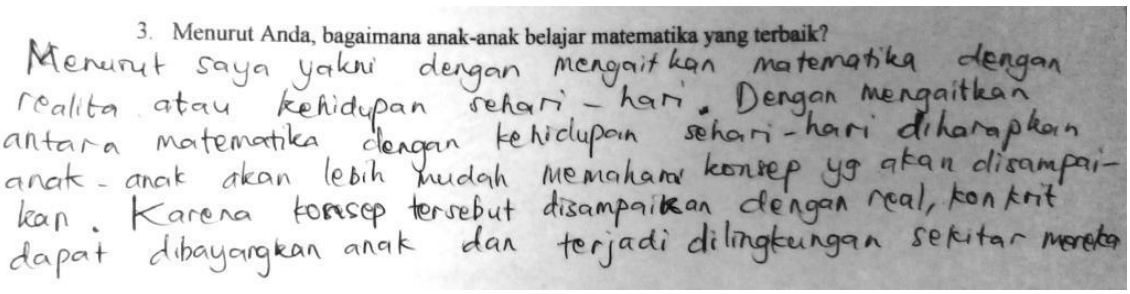
3. Menurut Anda, bagaimana anak-anak belajar matematika yang terbaik?
Menurut saya yakni dengan mengaitkan matematika dengan realita atau kehidupan sehari-hari. Dengan mengaitkan antara matematika dengan kehidupan sehari-hari diharapkan anak-anak akan lebih mudah memahami konsep yg akan disampaikan. Karena konsep tersebut disampaikan dengan real, konkrit dapat dibayangkan anak dan terjadi dilingkungan sekitar mereka

Figure 1. *Sarijem's statement about the best way to learn mathematics*

Translate: 3. In your opinion, how can children best learn mathematics?

Sarijem's Answer: In my opinion, it is best to associate mathematics with reality or everyday life. By linking mathematics to daily life children will easily be able to understand the concepts that are being delivered. Because the concept is presented with something that can be imagined by children and occurs in the environment around them.

In the interview and discussion sessions, Sarijem stated that "...by associating mathematics with daily life experiences, students can easily find and grasp the concept if they can imagine it." Moreover, Sarijem also stated that "... it is difficult for the students, especially in elementary school, if mathematics is not associated with anything they can imagine." Sarijem's beliefs about the best way of teaching and learning mathematics are consistent with her beliefs that mathematics cannot be separated from the human context and everyday life.

In the questionnaire, Sarijem stated that the teacher's role in learning is as a facilitator in guiding students to discover new knowledge. Meanwhile, the student's role is as a person seeking information or knowledge. Sarijem's statement was in line with the constructivist view which proposes that the conception and understanding of learners come from the construction of meaning where learners are involved in the process of building the individual interpretation of their experiences (Applefield, Huber, & Moallem, 2000; Kundi & Nawaz, 2010; Ari, Tunçer, & Demir, 2016). The following is Sarijem's statement about the role of teachers and students in mathematics class.

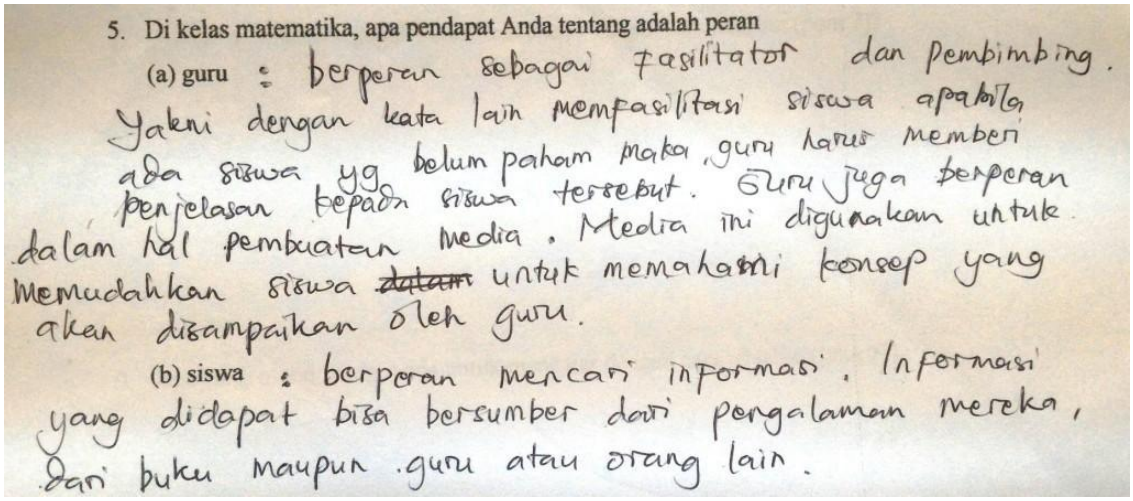
5. Di kelas matematika, apa pendapat Anda tentang adalah peran
(a) guru : berperan sebagai fasilitator dan pembimbing. Yakni dengan kata lain memfasilitasi siswa apabila ada siswa yg belum paham maka guru harus memberi penjelasan kepada siswa tersebut. Guru juga berperan dalam hal pembuatan media. Media ini digunakan untuk memudahkan siswa ~~dalam~~ untuk memahami konsep yang akan disampaikan oleh guru.
(b) siswa : berperan mencari informasi. Informasi yang didapat bisa bersumber dari pengalaman mereka, dari buku maupun guru atau orang lain.

Figure 2. *Sarijem's statement about the role of teachers and students*

During the discussion sessions and interviews, the researchers identified what is believed by Sarijem about the role of teachers and students is very close with her knowledge of the theory and learning perspective. However, Sarijem's incomplete understanding about the meaning of "teacher as a facilitator" and "students as active constructors" causes what is known as a fallacy of beliefs. When asked about how to facilitate student learning, Sarijem expressed a way to help students who are having difficulty and assisted them in finding solutions to problems, while actively connecting with the activity of thinking.

> The researcher: At the time of facilitating the students, they were expected to participate actively in the learning process. What are the conditions or situations in which the students can be described as active?
>
> Sarijem: When teachers ask open-ended questions or probing questions so that students can think of the problems encountered.
>
> The researcher: So, do you think active in this respect is when students think about the problems through the questions that you asked?
>
> Sarijem: Yes sir, (with accompanying assertion) ... when students are thinking, that means they're being active, sir.

I found that during the interview session, Sarijem's beliefs about teaching have been including her beliefs about learning explicitly. Sarijem adopts beliefs about learning in the perspective of a teacher, so when thinking about the best way to learn mathematics, it is always expressed with how to make students learn the best (a related approach to teaching the teacher to make students learn the best). Thus, the beliefs held by Sarijem about learning mathematics can be said to be a subset of beliefs about teaching mathematics. The plausible reasons for this is because the beliefs about teaching mathematics are subjective or the implicit viewpoint of teachers on various types of teaching, the meaning of teaching and learning, the role of teachers and students in learning, how students learn mathematics and class activities related to teaching mathematics (Chan, 2004; Ernest, 1989; Thompson, 1992). In other words, beliefs about teaching mathematics include beliefs about learning mathematics.

Reflecting on Instructional Practices from Sarijem's Beliefs and some factors that limit it

Under certain circumstances, the instructional practices conducted by Sarijem reflect on what she believes. Sarijem believes that mathematics is a science that is very relevant to the context, the experience and the daily life of human beings, in line with the beliefs about teaching and learning expressed in a way of how to relate mathematics to the context, experience and the student's daily life. This reflects the beliefs held by Sarijem by always trying to initiate the material that she attributed to the context and experience of students. Sarijem also tried to mediate between mathematics and the "context" with the use of props and media.

Sarijem believes that her instructional practices are constructivist orientated because she considers that it integrates the "context" of students into mathematics learning in the classroom. She also felt that the media and props are indicators that she has applied constructivist-orientated practices. These practices are the reflection her beliefs that mathematics is relevant to the context of the students. However, referring to the opinion of Lakatos (in Ernest, 1991, 1998) and Hersh (1997), mathematics is a human activity, in which mathematical objects are in the nature of human knowledge and are a product of human findings. "Students are active" based on this view can be defined as the process of reinvention. Students build their own knowledge of mathematics as facilitated by their teachers. This is in contrast to what happens in Sarijem's class, the use of media and props are more dominated by teachers as a model. Most students act as spectators of what is practiced by the teacher. This is inconsistent with what has been stated that the teacher acts as a facilitator while students are active constructors of knowledge. The instructional practices are more likely to reflect the beliefs held by Sarijem that mathematical objects can only be discovered by mathematicians, the only people capable of specifically discovering and formalizing forms of mathematics. Mathematics are accepted as true, so that students are asked to be "users", which record what is seen and heard and then just apply it. I identified that Sarijem's knowledge of the philosophy of mathematics and learning theories less profoundly form the fallacy beliefs whose practices refer to what she believed was true.

When explaining the solutions to solving problems related the greatest common factor (GCF) and least common multiple (LCM), Sarijem uses factor trees for prime factorization. Sarijem explained that the rules of using the factor trees start by dividing the number interested with the smallest prime number. In the interview, Sarijem explains that such a rule is easily memorized, making it likely students will also find it easy to learn. Sarijem states that the rule is fixed, so in order to solve mathematical problems, users must be use rules that already exist. The following is an excerpt of the interview when discussing the process of explaining the solution GCF (24, 32)

The researcher: Why did you divide by two, why not four or eight?

Sarijem: Actually, it's not always two, sir. According to my memory, in order to find the GCF and LCM by prime factorization, we should start from the smallest prime number first, sir. So, when it cannot be divided by 2, then it can be continued by dividing by 3 and so on, instead of four or eight, because they are not prime numbers. Textbooks, too, start from the smallest prime number anyway, sir.

The researcher: So, should we not be numbers other than prime numbers? Why is that?

Sarijem: No sir, because that is the rule, sir. During my own school experience, rules were like that.

The researcher: Ok. Now, I would like to ask why we are looking for the GCF and LCM by finding prime factors? Why not factor of other numbers?

Sarijem: I do not know sir, that's the rule of the finding the GCF and LCM, sir (laughing).

Sarijem's practices, which emphasized the rigid rules and procedures when explaining the prime factorization, are consistent with her beliefs that mathematics is an accumulation of facts, rules and procedures and then using said knowledge to solve the problem that is accepted as true. What she believes contradicts the constructivist view, which states that mathematics is not discovered, but constructed by humans so that the rules and procedures of mathematics can be created by anyone. Thus, mathematical problems can be solved by various methods or approaches that can be undertaken by students. Students can be guided to find a canonical sequence of 24 and 32 in their own way. Some examples of how using mental strategies can be illustrated as follows (Purnomo, 2014).

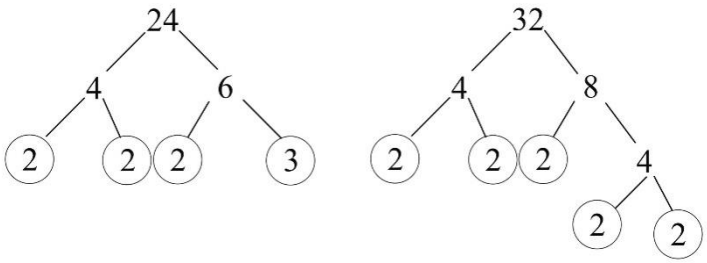

Figure 3. *The Mental Strategies factorization*

I identified that in addition to the previous school experiences, the lack of mathematical knowledge for teaching also became contributing factors which lead to practices that affect Sarijem's approach towards instrumental teaching. Sarijem did not yet realize that looking for LCM and GCF can be done using prime factorization epistemologically. I use the term "epistemological content knowledge" as one of the forms "mathematical knowledge for teaching" in this case. Epistemological content knowledge requires teachers to reflect epistemologically on mathematical structure as the foundation in establishing and communicating mathematical arguments. For example, the teacher must interpret and able to connect between the prime factorization and the fundamental theorem of arithmetic.

I also identified that the practice is carried out by Sarijem were more performance-orientated, which is focused on the students' ability to work on the problems quickly and correctly. The practice also still focused on the textbook as the main reference to teaching and did not dare to abandon the habit of using the rules contained in the book. Sarijem

admitted that while in school, she was also taught to do so by her teacher, so it feels odd to not follow the rules out of habit. This instrumental teaching resulted in students learning leads to a superficial learning dominated by memorizing facts and rules. Consequently, students often experience errors, do not interpret what was done, and lack the sensitivity and ability of a problem solver (Purnomo, Kowiyah, Alyani, & Assiti, 2014; Yang & Wu, 2010).

Focusing on the interaction between students and teachers, the interaction was dominated by one-on-one dialogue between Sarijem and her students. The dialogue was conducted by Sarijem using probing questions. High frequencies shown that Sarijem would come near to students to seek information through a series of questions that are guiding towards the discussion. Sarijem believed that was one way of making the students actively engage in the learning process. Sarijem uses questions as a way to assess the experience and knowledge of her students. In other words, the richer the feedback obtained from the students, teachers will increasingly understand the weakness and can continue to improve it. This strategy as suggested by some researchers uses effective questions, and is one of the strategies for integrating assessment into learning (Black, Harrison, Lee, Marshall, & Wiliam, 2003, 2004; Lee, 2006; Purnomo, 2015; Sumantri & Satriani, 2016). However, the peers involvement to provide feedback get less opportunity. The opportunity was not also provided in most of Sarijem's practices in the classroom, that the interaction between students and peers received less emphasis. This fact is not consistent with what she declared that students who engage in collaborative learning always benefit in their learning.

In interviews and discussion sessions, Sarijem stated that the opportunity to do collaborative learning is difficult because of time pressure and the material must be prepared by the mid-term deadline. Furthermore, Sarijem also realized that the practice that was planned was constrained by the learning environment, especially the behavior of students in the classroom. Sarijem realized that she could not organize the class because of the number of students, which exceeded the quota. For these reasons also, Sarijem had to limit the process of discussion between the teacher and the student.

Conclusions

This research examines the beliefs and practices of pre-service elementary school teacher early in her experience teaching mathematics. The findings of this study indicate that (1) beliefs about the nature of mathematics held by Sarijem are more traditional than her beliefs about teaching and learning mathematics, (2) the practices that are done by Sarijem are primarily more traditional than constructivist, and (3) the instructional practices do not always reflect on the beliefs that Sarijem holds. The complex relationship of related beliefs and practices were also encountered by some previous researchers (e.g., Barkatsas & Malone, 2005; Raymond, 1997; Shield, 1999). Some identified factors restricting the practice of Sarijem in mathematics class so that it is not always consistent with her beliefs, including the previous school experience, social norms, mathematical knowledge for teaching, the attitude that dares not to act out of habit, time constraints, high-stakes testing, curriculum, student behavior and the learning environment. Further, inconsistencies between beliefs held by Sarijem were influenced by the weak knowledge of the philosophy of mathematics and the learning theory.

The findings of this study indicate the important role of the philosophy of mathematics, as proven instructional practices done by Sarijem more reflected her beliefs about the nature of mathematics. This can also be found in previous studies (e.g., Perkkilä, 2003), which reveals that beliefs about the nature of mathematics contribute more strongly than other beliefs. Chassapis (2007) proposed some arguments about the philosophy of mathematics

that hold a key position in the professional knowledge of mathematics teachers. The first argument confirmed the direct relationship between the philosophy of mathematics and the basic features of mathematics education. The second argument is that the ideas, views, conceptions, or beliefs about mathematics teachers, teaching, and learning, reflected or related to the philosophy of mathematics implicitly. The third argument stated the undoubted assumption that the philosophy of mathematics is directly related to understanding the contents in mathematics as knowledge to be taught. It can be used as input to the curriculum of the Elementary School Teacher Education program to integrate the philosophy of mathematics into the philosophies that are commonly used in the current curriculum.

Continuous reform towards higher education curriculum in Indonesia generally and Education Studies Program for elementary school teachers in particular have become a necessity. It is important that in addition to the knowledge of content, mathematical content knowledge for teaching also needs to be stressed. It is none other than the Education Studies Program that is designed for the curriculum of elementary school teachers, who place more emphasis on aspects of mathematical content knowledge and is more oriented to high-level cognitive abilities, but the integration of mathematical knowledge for teaching is weak.

The importance of practical experience for pre-service teachers also needs to be addressed by policy makers at the higher education level, by integrating field experience on an ongoing basis and not just at the end of their coursework. It is useful to provide an opportunity for pre-service teachers related to the self-reflection of instructional practices in the classroom as the way to develop knowledge and beliefs or maybe refine them in the future. This can be done in several ways, such as (1) involving pre-service teachers in self-study to either himself or the teacher's example as the subject, (2) making the program provide an opportunity for pre-service teacher ' observations in schools, and (3) involving pre-service teachers in research activities on an ongoing basis.

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